



ABSTRACT

This study estimated the elemental, phytochemical, and proximate composition of the roots of *Leptadenia pyrotechnica* (Forssk.) Decne, a medicinal desert plant widely used in traditional medicine. Root samples were collected from Gashua, Yobe State, Nigeria, air-dried, powdered, and analyzed using standard laboratory procedures. Elemental composition was determined using Atomic Absorption

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STIMATION OF THE ELEMENTAL, PHYTOCHEMICAL AND PROXIMATE COMPOSITION OF THE ROOTS OF LEPTADENIA PYROTECHNICA (FORSK.) DECNE

***GAMBO, MOHAMMED SANUSI;**

****ADDA'ULLAHI, MOHAMMED; *AYUBA**

JOHN BUBA; & *ATIKU ISMAIL

*Department of Science Laboratory Technology, College Of
Agriculture, Science and Technology Ganye, Adamawa State.

**Department of Science Laboratory Technology, Federal
polytechnic Kaltungo, Gombe State

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INTRODUCTION

Medicinal plants continue to play an essential role in primary healthcare systems, particularly in developing countries where access to modern medicine is limited. A large proportion of the global population relies on plant-based remedies for the prevention and treatment of various diseases. Medicinal plants are valued not only for their therapeutic applications but also for their nutritional importance, as many contain essential minerals, dietary fibre, and bioactive secondary metabolites such as flavonoids, tannins, alkaloids, saponins, and terpenoids. These phytochemicals are widely reported to possess antioxidant, anti-inflammatory, antimicrobial, and pharmacological properties that contribute to human health (Kumari *et al.*, 2025;



Spectrophotometry (AAS), while proximate analysis was carried out following AOAC methods. Qualitative phytochemical screening was conducted using established protocols. The elemental analysis revealed high concentrations of calcium, potassium, and magnesium, moderate levels of phosphorus and nitrogen, and low concentrations of aluminium, silicon, sulphur, iron, zinc, manganese, and chlorine, while copper and cadmium were absent. Proximate analysis showed high crude fibre (50.0%) and dry matter (95.0%), moderate carbohydrate content (34.53%), and low levels of crude protein (2.97%), crude fat (6.0%), ash (1.5%), and moisture (5.0%). Phytochemical screening indicated the presence of flavonoids, tannins, and terpenoids in high to moderate concentrations, while alkaloids, saponins, and steroids were fairly present. The findings suggest that the roots of *Leptadenia pyrotechnica* are rich in essential minerals, dietary fibre, and bioactive phytochemicals, which support its traditional use in the management of ailments such as rheumatism, joint pains, sciatica, and as an anthelmintic. Further studies are recommended to explore its pharmacological and therapeutic potentials.

KEYWORDS: leptadenia pyrotechnica (forsk.) Decne, Phytochemical, proximate

Mohamud et al., 2025). *Leptadenia pyrotechnica* (Forssk.) Decne. Is a xerophytic desert shrub belonging to the family Apocynaceae (subfamily Asclepiadoideae), widely distributed across tropical Africa, the Middle East, and South Asia. The plant is commonly known as Khimp in India and Pakistan, Marakh in Arabic-speaking regions, Mirug in Somalia, Kalumbo in Niger, Namijin yaadiyaa in Hausa, and Kalimbo in Kanuri communities. Due to its ecological resilience and ethnomedicinal importance, the species has gained increasing scientific attention in recent years (Idrees et al., 2025; Kumari et al., 2025).

Botanically, *L. pyrotechnica* is an erect, virtually leafless perennial shrub reaching approximately 1–3 m in height, characterized by smooth green succulent stems and slender whip-like branches adapted to arid environments. The flowers are yellowish-green and occur in small cymes, while the fruits consist of follicles containing linear seeds with silky pappus that facilitate wind dispersal. These morphological adaptations enable the plant to survive extreme environmental conditions such as drought and high temperature (Kumari et al., 2025). Ethnobotanical studies have documented the traditional use of *L. pyrotechnica* in the management of rheumatism, joint pains, sciatica, backache, kidney disorders, and parasitic infections. The plant is also used as an anthelmintic, fumigant, and



food source in some communities, while its fibres are utilized for domestic purposes. Recent pharmacological investigations have reported antioxidant, antibacterial, diuretic, cytotoxic, and immunomodulatory activities, supporting many of its traditional applications (Mohamud *et al.*, 2025; Ibrahim & Ahmed, 2025; Heliyon, 2023).

Despite its widespread traditional use, comprehensive scientific data on the elemental, proximate, and phytochemical composition of the roots of *Leptadenia pyrotechnica* remain limited. Elemental analysis is important for evaluating nutritional benefits and potential toxicological risks, while proximate and phytochemical analyses provide insight into the nutritive value and therapeutic potential of medicinal plants. Furthermore, recent studies have emphasized the importance of investigating desert plants due to their unique metabolic adaptations and associated microbial interactions (Dammati, 2025; Kumari *et al.*, 2025).

Therefore, the aim of this study was to estimate the elemental, phytochemical, and proximate composition of the roots of *Leptadenia pyrotechnica* (Forssk.) Decne., in order to provide scientific validation for its traditional uses and contribute baseline data for future pharmacological and nutritional research

Reagents

Sodium hydroxide (NaOH), Sulphuric acid (H₂SO₄), Hydrochloric acid (HCl), Phenolphthalein indicator, Petroleum ether, Distilled water, Boric acid

Apparatus

Test tubes, Metal tongs, Dessicator, Pipette, Distillation stand, Oven, Digester

Sample Collection and Preparation

The roots of *leptadenia pyrotechnica* was collected from the outskirts of Gashua, Yobe State, Nigeria, the roots were identified by Mallam Grema, Department of Biological Sciences, University of Maiduguri. The roots were air dried at room temperature till they were properly dry and were then grounded into fine powder using mortar and pestle to reduce sampling error and then stored in a dark coloured sample bottle to protect from sunlight.

Elemental Analysis

The root sample was screened for some elements using the Atomic Absorption Spectrophotometer (AAS) technique.



Principles of the Atomic Absorption Spectrophotometer (AAS)

Flame atomic absorption spectrophotometer relies on the analyte solution being aspirated into a flame to produce a cloud of free atoms of the analyte element. This enables the atoms of the elements being determined to absorb radiation from a hollow cathode lamp which is unique to each element to be measured. The technique therefore provides high specificity and high sensitivity (Victor, 2000).

Proximate Composition Analysis

Proximate system of analysis developed by Henneberg and Stohmann in 1862 is used in nutritive studies. On the basis of this system, the sample is analysed for its content of Ash, crude protein, crude fiber, crude fat, moisture, dry matter. Using the AOAC 2000 method.

Moisture content

Two gram (2g) of the sample was weighed accurately and was put into a weight dried clean evaporating dish and sprayed. The dish was placed in an oven at 105°C for an hour and it was transferred into a desiccator and allowed to cool and weighed. The process was repeated until a constant weight was obtained.

$$\text{Moisture content (\%)} = \frac{A}{B} \times 100 \text{ in which}$$

A = Moisture losing

B = Original weight of sample

Ash Content

About 5g of prepared sample was weighed into a crucible and taken into hot furnace and incinerated at 550°C for five hours.

$$\text{ASH \% } x = \frac{\text{weight of sample after ashing}}{\text{weight of sample before ashing}} \times 100$$

Crude Protein

Three steps were involved

Digestive: - about 1g of prepared sample was weighed into 100ml flask and 200ml conc H_2SO_4 was added into the flask. The flask was heated and after about 3 hours a clear solution was obtained and it was allowed to cool. About 80ml of distilled water was added to dilute the solution.

Distillation: - about 50ml of 2% boric acid solution mixed with 2 drops of methyl red indicator was added into 250 flask and placed in a distillation unit. About 20ml of 40% NaOH solution was added into the flask containing the sample. The flask was connected to the steam jet arm of the distillation apparatus the steam was opened and the ammonia



liberated into the boric solution. Distillation was completed was complete when the liquid level in the flask reached the 75 mark and the liquid turn green in colour. The distillation was then titrated with 0.01N HCl.

$$\text{Protein \% } x = \frac{(A.B) \times N \times 14.01 \times 100 \times 6.25}{\text{Mg of the sample used}}$$

A = Titre value for sample

B = Titre value for blank

N = Normality of acid used

Crude Fat

2g of grinded sample weight into a porous thimble and placed in a soclet extractor and continuous extraction of oil was done for 4 hour using petroleum ether as the extracting solvent after the extraction, the extracting solvent was distilled off and evaporated. The difference in weight of the flask with oil and empty flask taken as weight of the extracted oil.

Crude Fiber

2g of sample was put into 250ml conical flask and 1.25% sulphuric acid was added. The sample was heated for about 30min and was filtered using vacuum filter and washed until traces of acid was undetected using ph paper. After that the acid extracted was transferred into 250ml conical flask and 1.25% NaoH solution was added. The sample was heated again for 30mins and was filtered using vacuum filter and washed with water until bases were undetected. The whole material was transferred into a crucible and dried for 12 hour at 120 degree. After that, the crucible was placed into muffle oven at 550 degree for 12 hours and weight of crucible was recorded.

Carbohydrate

The percentage of carbohydrate in the sample was calculated by differences. This means that from 100% the total or protein, fat, ash, moisture, was subtracted from 100% the remaining being percentage carbohydrate difference.

$$\% \text{ carbohydrate} = 100 - (\% \text{ protein} + \% \text{ fibre} + \% \text{ moisture} + \% \text{ fat} + \% \text{ moisture})$$

Phytochemical

The phytochemical screening of powdered leaf extract was carried out and this is aimed at providing evidence in support of the claim biological effects or activities. Thus, this screening proves the presence of new compounds in plants or discovered already in



plants that were not documented to have such activity. The screening carried out include: Tannins, Alkaloids, Saponins, Flavonoids, Steroids and terpenes.

Saponins

The froth method was used for this test as follows: To a sample quantity of the powdered sample, 95% ethanol was added and boiled. The mixture filtered and 2.5mls of the filtrate was added to 10mls of distilled water in a test tube. The test tube was stopped and shaken vigorously for about 30sec. It was then allowed to stand for over 30mins. Honey crab froth is an indication of saponins (Sofowora, 1993).

Tannins

A total of 3g of the powdered sample was boiled in 50mls of sterile distilled water for 3min on a hot plate. The mixture was then filtered and the resulting filtrate was used to carry out the test for tannins using ferric chloride method. The test was carried out as follows: a portion of the aqueous extract was diluted with sterile distilled water in the ratio 1:4 and a few drops of 10% ferric chloride was added. A blue or green colour indicates the presence of tannins (Evans, 1989).

Flavonoids

A portion of 5g of the powdered sample was completely extracted with acetone. The residue was extracted in warm water after evaporating with acetone on water bath. The mixture was then filtered and the filtrate was used for the test (Segelmann *et al*, 1971). The NaOH method was used for the test. A portion of 5mls of 10% NaOH was added to an equal volume of the extracted water. A yellow solution indicates the presence of flavonoids.

Alkaloids

A portion of 10g of the powdered sample was taken in a small beaker and a strong solution of ammonia solution was added in a quantity sufficient to just moisten it and allow it to stand for 10mins after thorough mixing of the content. Sufficient quantity of a mixture of chloroform and ethanol 1:1 was added just to soak and suspend the powder. The mixture was allowed to stand for 20mins with occasional stirring with a rod, the mixture was filtered through a plug of cotton wool, the residue was washed twice with the 2mls of chloroform and the washing was combined with the filtrate, the bulked filtrate was concentrated to dryness without overheating. The residue was cooled and dissolved in 5mls of chloroform only. The chloroform solution was transferred to a small separating



funnel and shaken with 3mls of dil sulphuric acid. The two layers were allowed to separate, the chloroform lower layer was drained off and discarded. 3mls of chloroform was further added and shaken, drained off and discarded until upper acid layer was colourless. The acid layer was completely made alkaline with strong ammonia solution (tested with indicator paper). The extraction with chloroform extract was refined and evaporated to dryness. The residue was dissolved in 3mls of ethanol and the test was carried out after neutralizing with dil sulphuric acid (Brain and Turner, 1975).

A set of 5 test tubes was taken for sample. To each of the ethanolic solution from above was added drop wise to a few drops of the following reagents.

Meyers reagent – (Potassium mercuric iodine solution) Drangendroffs reagent (potassium bismuth iodine solution) Wagners reagent (solution of iodine in potassium iodide solution) Hagers reagent (a saturated solution of picric acid) Tannic acid solution.

The presence of precipitate in at least 3 of the above reagent indicates the presence of alkaloids (Evans, 1989).

Test for Terpenes and Sterols

A 5g portion of each of the powdered sample was extracted by maceration with 50mls of 95% ethyl acetate, filtered and the filtrate was evaporated to dryness. The residue was dissolved in 10mls of anhydrous chloroform and the filtrate was divided into 2 portions and the following test was carried out.

Lichermann-Burchard Test

The Lichermann-burchard test was used for the test. The first portion of chloroform above was mixed with 1ml of acetic anhydride followed by addition of 1ml of concentrated sulphuric acids down the wall of the test tube to form a layer underneath. The formation of a reddish violet colour indicates the presence to terpenes (Sofowora, 1993).

Salkowskis Test

The second portion of the solution was mixed 1ml of concentrated sulphuric acid carefully so that the sulphuric acid formed a layer. A reddish brown colour indicates the presence of a steroidal ring (Sofowora, 1994).

Elemental Composition

Table 1: shows the elemental analysis of some elements carried out on the roots of *Leptadenia pyrotechnica* (forsk.) using the technique of atomic adsorption



spectrophotometer and x-ray analyser. The values are represented as mean $\pm$ standard error of mean of three (3) readings. copper and cadium are found absent, Aluminium, Silicon, Sulphur, Iron, Zinc, manganese, Chlorine, are found very low, Phosphorus and Nitrogen are moderately found present while Calcium, Potassium and Magnesium are highly found in the analysis.

Table 1: Element composition of the roots of *Leptadenia Pyrotechnica* (Forsk.) decne.

ELEMENTS	MEAN $\pm$ S.E.M (Mg/L)
Si	0.1300 $\pm$ 0.0152
Al	1.4630 $\pm$ 0.0331
K	26.470 $\pm$ 0.2608
Ca	37.950 $\pm$ 0.1785
Mg	19.360 $\pm$ 0.0437
S	0.6950 $\pm$ 0.0028
Fe	1.6480 $\pm$ 0.9514
Zn	0.9530 $\pm$ 0.0043
P	6.8663 $\pm$ 0.0163
Mn	0.0463 $\pm$ 0.0032
Cl	0.9506 $\pm$ 0.0006
N	5.4516 $\pm$ 0.0016

Phytochemical Composition

Table 2: shows the results of phytochemical, composition of the roots of *Leptadenia Pyrotechnica* (Forsk.) decne, using standard method of analysis (Evans, 1989 and Sofowora, 1993. the concentration of terpenoids, tannins and flavonoids are found higher than saponins, steroids and alkaloids which are fairly present in the roots.

Table 2: Phytochemical composition of *Letadenia Pyrotechnica* (Forsk.) decne.

PHYTOCHEMICALS	LEVEL
Alkaloids	+
Flavonoids	++
Saponins	+
Tannins	++
Steroids	+
Terpenoids	+++

Key: +++ highly present, ++ Moderately present, + Fairly present



Proximate Composition

Table 3: shows the result of the proximate composition of the root of *Leptadenia pyrotechnica* (forsk.) decne, using the method developed by Henneberg and Stohmann in 1862 which is used in nutritive studies. On the basis of this system, the sample is analyse for its content of ash, crude protein, crude fibre, crude fat, moisture, dry mater using AOAL 2000 method. The level of crude fiber and dry matter was high, carbohydrate was moderate while moisture content, crude fat, crude protein and ash are very low.

Table 3: Proximate composition of the root of *Leptadenia Pyrotecnica* (forssk decue).

Parameters	Value%
Ash content	1.5
Crude fiber	50.0
Crude protein	2.97
Carbohydrate	34.53
Dry matter	95.0
Crude fat	6.0
Moisture content	5.0

Discussion

The result of the roots of *Leptadenia pyrotechnica* (forsk.) decne, showed the presence of carbohydrate and fibre in high quantity and crude protein fat and Ash in low quality. The high alpha cellulose and low lignin content of the fibre with favourable length and breadth ratio of the ultimate cell makes it suitable for use in blending with cotton or polyester fibre to produce blended textile yarn and in pulp and paper industry (Goyal and Sharma, 2006). The health benefit of fibre is that it fights constipation by softening stool, increasing the speed at which food moves through the body, as such eating too much fibre may lead to diarrhoea, an exaggeration of what is supposed to be fibre benefit (Vandelay, 2009). In addition, excess fibre binds to metals zinc, iron and magnesium and these may lead to deficiencies in these nutrients (Nita, 2009).

Carbohydrate serves as source of energy for the plant and also serves as a food for livestock. The energy obtained from this carbohydrates is used by the animals for normal metabolic processes (Anne and Allison, 2006). Also the energy utilized by the tissue is used for physiological processes (Sembuligam and Prema, 2010).

The elemental results of some metals in the root of *leptadenia pyrotechnica* (forsk.) decne, such as Si, Al, K, Ca, Mg, S, Fe, Cu, Zn, Mn, P, Cl, N, and Cd shows the presence of K, Ca and Mg in high levels, Si, Al, S, Fe, Zn, Mn, P, Cl, and N were present in very low quantities while Cu and Cd were absent.



Calcium, potassium and magnesium are essential elements, calcium is a metallic element essential for the normal development and functioning of the body and is also an important constituent of bones and teeth (Skulan and Depaolo, 1997). Calcium is a co-factor playing an important role in the regulation of intermediary metabolism and also as an intracellular regulator of a large number of biochemical activities in various sub-cellular components (Maduka and Okoye, 2002).

Potassium is a mineral element which is an important constituent of the human body, it is the main base ion of intracellular fluid which helps maintain the isoelectrical potential of the nervous system (Gadsby, 2004). Potassium is important for proper membrane function, nerve impulses and muscle contractions (Kumar *et al.*, 1998).

Magnesium is essential to all living cells where it plays a major role in manipulating important biological polyphosphate compounds like ATP, DNA and RNA (Bernath *et al.*, 1985). Magnesium compounds are used medicinally as common laxatives and antacids (Wester, 1987). The result of the phytochemical screening of the roots of *Leptadenia pyrotechnica* (forsk.) Decne, showed the presence of flavonoids, terpenoids and tannins in higher levels than alkaloids, steroids and saponins. Flavonoids are becoming very popular because they have many health promoting effects. Some of the activities attributed to flavonoids include: anti-allergic, anti-cancer, anti-oxidant, anti-inflammatory and anti-viral (Lotito and Frei, 2006). Studies have shown that flavonoids prevent the oxidation of low-density lipoprotein, thereby reducing the risk of the development of atherosclerosis (Williams *et al.*, 2004).

Terpenoids are a large and diverse class of naturally occurring organic chemicals which are used extensively for their aromatic qualities. They play a role in traditional-herbal remedies which are anti-bacterial, anti-neoplastic and other pharmaceutical functions (Balandrin *et al.*, 1985).

Tannins have been reported to have anti-inflammatory effects and also inhibit absorption of minerals when ingested in excessive quantities such as iron, which may if prolonged lead to anaemia. This is because tannins are metal chelators and tannins chelated metal iron are not bio-available (McGee and Harold, 2004).

These functions of the phytochemicals that are present in this plant might be the reason why *Leptadenia pyrotechnica* (forsk.) Decne is useful traditionally in the treatment of rheumatism, joint pains, sciatica and backache as fumigant and anthelmintic.

CONCLUSION

In conclusion, the results of this study on the roots of *Leptadenia pyrotechnica* (forsk.) Decne, showed high levels of flavonoids, terpenoids, tannins, fibre, carbohydrate, potassium, calcium and magnesium which can provide support on the already existing literature on the use of *Leptadenia pyrotechnica* (forsk.) Decne traditionally in the



treatment of various diseases such as rheumatism, sciatica, joint pains and as anthelmintics, and further research to be carried out in this field. Traditional medicine is vital and therefore utilization of a natural plant material is a great step towards a developed nation.

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